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(54) Continuous paper sheet tearing-up apparatus.

(57) A continuous paper sheet having a plurality of transversal perforation lines and a plurality of holes formed in the longitudinal margines of the paper sheet. The paper sheet is torn by means of two pairs of nipping rollers including a pair of the upper and the lower feed-in rollers and another pair of the upper and the lower pulling rollers. The pulling rollers of the latter pair rotate higher than that of the feed-in rollers of the former pair so that the part of the sheet placed between the former pair of rollers and the latter pair of rollers are pulled or given tension, being torn and separated. After the continuous paper sheet is confirmed that it is placed on a stand at the predetermined position, the width or distance of the continuous paper sheet folded is measured. The resultant of measurement is compared to the standard sizes previously inputted in a CPU in order to correct it to the approximate standard size. According to the corrected standard size and the sheet thickness separately measure, the tearing-up operation of the pairs of the feed-in rollers and of the high speed or pulling rollers is controlled in order to give the continuous paper sheet a difference in transferring speed and to tear-up the sheet at the predetermined position of the sheet.

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Continuous Paper Sheet Tearing-up Apparatus

Background of the Invention

The present invention relates to a continuous paper sheet tearing-up or cutting apparatus provided with a pair of a upper infeed or feed-in roller and a lower infeed or feed-in roller, and another pair of a upper roller and a lower roller rotating at a rotary speed higher than that of the former pair of rollers, so that the difference between the feeding or advancing speeds of the continuous paper sheet fed through the former roller pair of a low-speed and the latter pair of a high-speed tears the paper sheet.

According to the first kind of the conventional paper tearing-up apparatus mentioned above, the continuous paper sheet is always held or nipped by a pair of upper feed-in roller and a lower feed-in roller, and another pair of upper and lower high speed rollers. Such conventional apparatus of the second kind holds or nips the continuous paper sheet only at the instant of tearing-up it by means of both the pair of rollers. According to the modification of the second conventional apparatus, the pair of the upper and lower feed-in rollers always holds the continuous paper sheet and the another pair of high speed upper and lower rollers nips the sheet only at the instant of tearing-up operation.

The inventor improved the conventional continuous paper tearing-up apparatus of the second kind and also the modification of the apparatus.

In general, concerning the conventional continuous paper sheet tearing-up apparatus of the second kind, it is necessary to install a paper sheet transfer apparatus, such as a tractor and the like in the apparatus and the distance between the pair of feed-in rollers and another pair of high speed rollers along the sheet transfer or feeding direction is not changed. The vertical approaching function of the feed-in rollers and the high speed roller in order to tear-up the continuous paper sheet is set so as to done at the instant or moment that the size of the sheet to be torn-up becomes corresponding to the length of the paper sheet fed through the transfer device, such as a tractor and the like.

Disadvantageously, according to the conventional apparatus of the second kind, it is necessary to precisely control the separating operation of both the pairs of feed-in rollers and high speed rollers in accordance with the length or volume of the paper sheet fed by the transfer mechanism, and previously to precisely measure the cutting or tearing-up size of the continuous paper sheet in order to fix the timing of a separation function. However, it has been difficult to precisely control the aparting operation of the pair of the upper and the lower feed-in rollers and another pair of the upper and the lower high speed rollers according to the particular tearing-up size of the paper sheet. In addition, when the thickness of the continuous paper sheet changes, the gaps between the upper rollers and the lower rollers correspondingly increase or decrease, so that it has been difficult to tear-up the continuous paper sheet through the right or precise position of the sheet, even when the separation function of both pairs of rollers is correctly carried out. When the tearing-up size of the continuous paper sheet is measured and the sheet is set uncorrectly on the sheet measurement mechanism, it is impossible to precisely measure the tearing-up size. If the tearing-up position of the paper sheet is determined according to the wrong measurement result, any precise control of the aparting functions of each pair of rollers doesn't enable to tear-up the paper sheet from its correct position or part.

Summary of the Invention

The present invention has been accomplished to solve the shortcomings resided in the conventional continuous paper sheet tearing-up apparatus of the second kind. So, it is the first purpose of the present invention is to provide a coninuous paper sheet tearing-up apparatus for precisely measuring the tearing-up size of the continous paper sheet and controlling the aparting operation of the pair of the upper and the lower feed-in rollers and the other pair of the upper and the lower high speed rollers.

It is the second purpose of the present invention is to provide a continuous paper sheet tearing-up apparatus enabling to set the gaps between the upper and the lower feed-in rollers, and between the upper and the lower high speed rollers at the instant of tearing-up.

It is the third purpose is to provide a continuous paper sheet tearing-up apparatus for correcting any error, if any, in the tearing-up size measured of the sheet paper in order to tear-up the continuous paper sheet at its correct position.

It is the fourth purpose is to provide a continuous paper sheet tearing-up apparatus which is made permitted to measure the tearing-up size only when the paper sheet is correctly set at its predetermined position.

It is the fifth purpose is to provide a compact continuous paper sheet tearing-up apparatus enabling to carry up a correct tearing-up operation.

In order to accomplish the first purpose of the

present invention, the continuous paper sheet tearing-up apparatus has a pair of the feed-in rollers and another pair of high speed rollers, both the pairs being separated along the horizontal direction and the rollers respectively in the same pair being arranged so as to approach each other and apart from the opponent along their vertical direction, a blade situated between the pair of feed-in rollers and another pair of high speed rollers, a paper sheet size measurement device for measuring at least the long side of the folded continuous paper sheet through, for example, an optical means, and an approach timing control device for controlling according to the measurement result a timing of the sheet nipping operations of the pair of feed-in rollers and another pair of high speed rollers along the vertical direction, and the approaching or nipping movements, respectively of both the pair of feed-in rollers and another pair of high speed rollers at the tearing-up time of the continuous paper sheet give a difference in the paper transfer speed and the blade is applied to the paper sheet so as to tear-up it at the same time. As described above, the high tearing-up precision of the paper sheet is attained by automatically measuring the long side or the length of the folded paper sheet and controlling the nipping timing of the pair of the upper and the lower feed-in rollers and another pair of the upper and the lower high speed rollers approaching vertically.

In order to attain the second purpose above, the continuous paper sheet tearing-up apparatus according to the present invention has a pair of feed-in rollers, another pair of high speed rollers, a blade, an input means for manually or automatically using various sensors inputting the information of a thickness of the continuous paper sheet to be torn, and a nipping-gap control means for controlling the vertical distances between the pair of feed-in rollers and another pair of high speed rollers. In consequence, it is possible to keep always the suitable distances or gaps of the upper roller and the lower roller according to the thickness of paper sheet by adjusting the distance between the upper roller and lower roller of each set of rollers on the basis of the thickness.

Further, in order to attain the third purpose of the present invention, the continuous paper sheet tearing-up apparatus provides with a pair of the upper and the lower feed-in rollers rotating at the predetermined speed, another pair of the upper and the lower high speed rollers rotating at the speed higher than the predetermined speed, a sheet size measurement device for measuring at least the length of the paper sheet folded in a shape of zig-zag, a standard size setting portion for setting previously a plurality of standard sizes of the continuous paper sheet, and a size adjusting portion for correcting the size of the paper sheet measured by the sheet size measurement device to a standard size nearing to and on the basis of the standard size set by the standard size setting portion so as to set the tearing-up position of the continuous paper sheet to be torn by the pairs of the feed-in rollers and the high speed rollers based on the standard size of the paper sheet corrected in the size adjusting portion. As described above, even though some error is occurred in the measurement of the paper sheet size, the error can be corrected on the basis of the standard size previously inputted and the tearing-up position of the continuous paper sheet is set enabling to tear-up the sheet always at the exact position.

Furthermore, in order to attain the fourth purpose, the continuous paper sheet tearing-up apparatus according to the present invention has a pair of the upper and the lower feed-in rollers, respectively rotating at the predetermined speed, a pair of the upper and the lower high speed rollers, respectively rotating at a speed higher than the predetermined one above, a sheet size measurement device for measuring at least the distance or length of the continuous paper sheet folded in a zig-zag and positioned on a stand of the paper sheet, a detecting device for dispatching a placing signal when the folded paper sheet is placed on the stand at the predetermined position, and a measurement control portion for issuing size measurement ordering signals to the sheet size measurement device, in order to set the tearing-up position of the continuous paper sheet torn by the pair of the feed-in rollers and another pair of high speed rollers based on the sheet size signals from the sheet size measurement device. It is noted that when the continuous paper sheet folded is not placed on the stand at the predetermined position, no measurement of the sheet througn the sheet size measurement device is done. In consequence, it is said that the sheet is always measured correctly.

In order to attain the fifth purpose, the continuous paper sheet tearing-up apparatus according to the present invention has a pair of the upper and the lower feed-in rollers rotating at the predetermined speed and nipping the sheet at least at the tearing-up instant, a feeding portion for transferring or feeding the continuous paper sheet, a pair of the upper and the lower high speed rollers rotating at the speed higher than the pair of the feed-in rollers and approaching each other at the tearing instant so as to nip the continuous paper sheet running through the rollers in order to tear-up the paper sheet using the speed difference of the high speed rollers from the feed-in rollers, a sheet edge detection portion for detecting the front edge of sheet transf rred to that position, a tearing-up size input

portion, for example a sheet size measurement apparatus, for manually or automatically inputting the tearing-up size of the continuous paper sheet and a control means for controlling the approaching operation of the pair of the upper and the lower high speed rollers according to the signals from the sheet edge detection portion, a tearing-up size signal dispatched from the tearing-up size input portion (or a sheet size signal from the sheet size measurement apparatus), and information of the transferred length of the continuous paper sheet at the feeding portion. Because that the continuous paper sheet tearing-up apparatus of the present invention has the feeding portion having a sheet transfer function, it is possible to transfer the continuous paper sheet without installation of the transfer device, such as a tractor mechanism and the like. Control of each high speed rollers carried out on the basis of a transfer length of the continuous paper sheet fed through the feeding portion and the tearing-up size enables the continuous paper sheet tearing-up apparatus to carry out a correct tearing-up operation.

Brief Description of the Drawings

Of Figs 1 - 9 depicting the preferred first embodiment of the continuous paper sheet tearing-up apparatus according to the present invention,

Fig 1 is an outline view of the whole construction of the continuous paper sheet tearing-up apparatus,

Fig 2 is a side elevation of the pair of the upper and the lower feed-in rollers and another pair of the upper and the lower high speed rollers and a moving mechanism for driving the respective rollers vertically,

Fig 3 is a plan view of the stand including the paper sheet size measurement device,

Figs 4 and 5 are sectional views of the stand of the paper sheet measurement device,

Fig 6 is a plan view of the continuous paper sheet,

Fig 7 is a flowchart of a sheet size measurement and a correction operation to the standard size,

Fig 8 is a flowchart showing the control operation of CPU relative to the moving mechanism for driving the feed-in rollers and the high speed rollers along the vertical approaching and separating direction,

Fig 9 is a time chart depicting the output condition of control signals corresponding to the sheet thickness.

Of Figs 10 - 12 depicting the preferred second embodiment of the present invention,

Fig 10 is an outline of the whole structure of the continuous paper sheet treatment apparatus,

Fig 11 depicts the feeding portion provided with a pair of the upper and the lower feed-in rollers, another pair of the upper and the lower high speed rollers and a moving mechanism for driving respective rollers along their approach and separate vertical direction, and

Fig 12 is a perspective view showing the feeding portion.

Detailed Description of the Invention

As described in detail in Fig 1, the continuous paper sheet 1 to be teared-up to the unit sheet 1a is placed on the placing stand 3 at its predetermined position. The paper sheet 1 is folded through the perforations for bending and tearing-up the sheet in a shape of zig-zag and placed on the stand 3. The stand has a sheet size measurement device therein for measuring the width and the length of the folded sheet, or these distance of the width and the length of the unit sheet 1a. As seen in Fig 6, the continuous paper sheet 1 has marginal portions 5 and 5 formed at the both sides along the longitudinal direction of the sheet, being bounded by tearing-up perforations 4 and 4. In the marginal portions, there are a plurality of marginal holes 6 and 6 separated uniformly along the axial direction of the sheet.

Next, the sheet size measurement device will be explained. As shown in Fig 3, the stand 3 has a ceiling plate 3a on which the continuous paper sheet 1 is placed. There are, on the ceiling plate 3a, a long light transparent plate 7 extending along the width direction of the continuous sheet and measuring the width of the unit paper sheet 1a, and another long light transparent or transmitting plate 8 extending along the direction perpendicular to the direction of the light transparent plate 7 and measuring the length or depth of the unit paper sheet 1a along its continuous or extending direction. As shown in Fig 4, at the position corresponding to the light transparent plate 7 formed in the ceiling plate 3a, a rotary shaft 11 rotatably supported on the support plates 9 and 10, respectively fixed in the stand 3 extends. A phototube 12 having a rotation preventor (not shown) is fixed to the rotary shaft 11. At one end of the rotary shaft 11, there is a driving motor 13 fixed thereto. At another end of the shaft, there is a slit plate 14 fixed thereto. Corresponding to the lower edge of the slit plate 14, there is a slit direction device 15 fixed to a supporting plate 10. On the supporting plate 10 and another supporting plate 9, there are respective limit switches 16 and 17 installed so as to be matched with a travelling route of the phototube 12. The mechanism or construction mentioned above

measures the width of the unit sheet 1.

While, as shown in Fig 5, at the position corresponding to that of the light transparent plate 8 in the stand 3 on which the paper sheet is placed, a mechanism for measuring a depth of the unit sheet 1a is placed, which mechanism having a phototube 18 and is similar to that measuring the width of the unit sheet 1a as described above. Concerning the mechanism for measuring a depth of the unit sheet, the same reference numerals with affixes "a" are applied to the respective construction parts corresponding to the parts of the width measurement mechanism above and a detailed explanation for the depth measurement mechanism is omitted.

In operation of the continuous paper sheet tearing-up apparatus according to the present invention, the width and the depth of the unit sheet 1a are measured by rotation volumes of the rotary shafts 11 and 11a of each phototubes 12 and 18. The rotation volumes are changed to the passing number of slits of equal pitches of beams from the phototubes 12 and 18, and then the passing number is detected by the slit detection mechanisms 15 and 15a. The sheet size signal detected is sent to the size controlling portion of a CPU 19 through a measurement controll portion C shown in Fig 1.

A sensor S_1 for detecting the continuous paper sheet 1 correctly placed on the predetermined position of the ceiling plate 3a is installed at the position along a wall plate (not shown) of the continuous paper sheet treating apparatus. A pair of sensors S_2 and S_2 for detecting the continuous paper sheet 1 wrongly placed on the ceiling plate 3a are installed at these longitudinal ends of the light transmitting plate 7. The detection apparatus S consisting of the central sensor S_1 and two side sensors S_2 and S_2 is adapted to dispatch a placement signal when the continuous paper sheet 1 is placed at the predetermined position. In consequence, the placement signal is issued when the sensor S_1 is ON and these sensors S_2 and S_2 are OFF. When a placement signal is issued from the detection apparatus S, a size measurement order signal is issued from the measurement control portion C to the sheet measurement size apparatus. A sheet size signal from the slit detection devices 15 and 15a of the sheet measurement size apparatus is sent to the size control portion through the measurement control portion C.

The size control portion compares the inputted measurement value to the standard size set and sustained in the standard size setting portion in the CPU 19 in order to correct it to the nearest standard size. When the measured value is situated, in the correction operation, at the center or mid of two standard sizes, it is raised to the larger standard size so as to correct the measurement value. The standard size setting portion has the width standard sizes of the unit sheet 1a in the unit of 1/10 inch and the depth standard sizes of the unit sheet 1a in the unit of 1/2 inch. The number of the width and the depth standard sizes are suitably determined and set in the setting portion.

As shown in Fig 1, the continuous paper sheet 1 placed on the stand 3 is pulled or drawn out upwardly and guided on a guide plate 49. The marginal holes 6 and 6 formed at both the margins of the paper sheet 1 are engaged with trancting pins of the tractor 20 driven by a main motor 21. Thus, the paper sheet 1 is fed rightwardly on the sheet of Fig 1. The transfer or feeding speed of the paper sheet 1 is detected through a detector 23 installed in the tractor encoder 22 for detecting the number of rotation of the tractor 20 and the detected speed signal is sent to the CPU 19. A slitter 24 installed near the rearward end of the tractor 20 cuts off the margins 5 and 5 from the sheet 1 through its perforations 4 and 4, the sheet 1 is further sent along the same direction, and it is supplied to a tearing-up apparatus.

The two wheels of the tractor 20 are controlled or moved by a lunction of the gear 41 to which a driving force of the sub motor 40 is transferred and the distance between these wheels are determined. The slitter 24 is moved together with the tractor 20. The motor 40 is driven and controlled by a control signal from the CPU 19, which control signal being attained by correcting the resultant width distance of the unit sheet 1a measured by the sheet size measurement apparatus. The opposing distance between the wheels of the tractor 20 is set at that value narrower than the width of the continuous paper sheet 1 measured by the phototube 12 by 0.5 inch, so that the marginal holes 6 and 6 placed inside from the longitudinal edges of the paper sheet by 0.25 inch are matched to the tractor pins.

A set of sheet thickness detectors 25a and 25b for detecting the sheet thickness according to the light transmitting volume at the three steps of "thin", "middle" and "thick" are placed opposedly along the vertical line sandwiching the traveling route of the continuous paper sheet 1, dispatching a detection signal to be sent to the CPU 19. These sheet thickness detectors 25a and 25b construct an input means for inputting information of the paper sheet thickness of the continuous paper sheet 1.

As shown in Fig 1, following the paper sheet thickness detectors 25a and 25b, there are a pair of the upper and the lower feed-in rollers 26a and 26b enabling to apart and approach along the vertical direction, and another pair of the upper and the lower high speed rollers 27a and 27b situated after the former pair of rollers. The gaps between the upper rollers and the lower rollers of these pairs are about 1 t0 1.5 mm.

Between these pairs of the feed-in rollers 26a

and 26b, and of the high speed rollers 27a and 27b, there are a blade 28 to be applied to the perforations 2 extending along the depth direction (see Fig 6) so as to bent and tear-up the continuous paper sheet 1, and a sheet edge detector 29 of a high reflection type for detecting the front edges of the sheet. When the front edge of the continuous paper sheet 1 of the paper sheet front edge detector 29, the detector 29 outputs detection signals to the CPU 19.

With reference to Fig 2, a moving mechanism for moving or driving respective pairs of the feed-in rollers 26a and 26b, and the high speed rollers 27a and 27b toward each other or another pair of rollers will be explained. Each rotary shaft 30 and 31 of the lower feed-in roller 26b and the upper high speed roller 27a are supported eccentrcially by bearings 32 and 33. Rotary shafts (not shown), respectively installed at the centres of the bearings 32 and 33 are born rotatably at the machine frame (not shown). As shown in Fig 1, around a driving plate 35 fixed to an output shaft of a motor 34 and these bearings 32 and 33, an endless belt 36 is wound. The pulse motor 34 is connected to the CPU 19 functioning or controlling the approach timing, and its output shaft rotates by the predetermined volume along the predetermined direction by a driving control signal according to the depth standard size corrected in the size control portion of the CPU 19. Accordingly, also the driving plate 35 rotates along the same direction and by the same volume as these of the output shaft. The rotation is transferred to respective bearings 32 and 33 through the endless belt 36. Owing to the rotation of the bearings 32 and 33 around shafts (not shown), the rotary shafts 30 and 31 rotate in an arc shape along the same direction.

In condequence, when the driving plate 35 rotates by the pulse motor 34 clockwise on Fig 2, the roller 26b is raised and the ro-ler 27a downs, approaching to each other. On the contrary, when the driving plate 35 returns counterclockwise, the roller 26b rises and returns to its original position. As a result, when the rotary volume of the output shaft of the pulse motor 34 is controlled by the CPU 19, the gaps or vertical distances between the feed-in rollers 26a and 26b, and the high speed rollers 27a and 27b are controlled and then the tearing-up position of the continuous paper sheet 1 is set with the controlled least distance of the rollers. The traveling mechanism and the CPU 19 constructs a distance control means.

As shown in Fig 1, after the tearing-up mechanism, there is a stacker device for sequentially stacking the unit sheets 1a cut. This stacker device has an elevatable table 36 on which the unit paper sheets 1a are placed. In order to firmly and one by one stack the unit sheets 1a on the elevatable table 36, a conveying guide belt 37 is placed at a suitable position, which belt having two thin belts (one belt is shown) running in parallel and along a circular route in order to pull-in the unit sheets 1a. The sheet pull-in speed of the thin belts in higher than the sheet push-out speed of the tearing-up apparatus. Further, a stopper 39 movable along the advancing direction of the unit sheets and on which the front edges of the unit sheets 1a are hit, and a stacked sheet volume delecting divice 38 for detecting the position or level of the uppermost or top unit sheet 1a of the heap of unit sheets on the elevatable table 36 and issuing a detection signal for lowering the table 36 when the detected level becomes higher than the predetermined one to the CPU 19 are installed on the tearing-up apparatus as shown in Fig 10.

The conveying guide belt 37 has a pair of driving rolls 50 on which the thin belt is wound and the rolls have projections on their peripheries, so that a part of the thin belt intermittently is pushed down by the projections. As a result, even some error is generated in a descending motion of the elevatable table 36 and the table descends a little lower than the correct height, the conveying guide belt 37 can firmly engage with unit sheets 1 to convey it and the unit sheet 1a strikes with the stopper, so that the unit sheet 1a is always lightly and smoothly stacked on the elevatable table 36.

The operation of the preferred embodiments of the continuous paper sheet tearing-up apparatus according to the present invention constructed as described above will be explained.

First, as shown in Fig 1, the continuous sheet 1 is placed on the placement table 3 in a manner of the predetermined folded condition at the predetermined position of the table 3 and a measurement operation of the sheet size is carried out. The measurement operation is explained with reference to Fig 7, together with the control operation of the CPU 19.

When the continuous paper sheet 1 is stacked on the table 3 in a manner of the predetermined folded condition, the sensors S_1, S_2, and S_2 sense or detect the heaping position of the continuous sheet 1 determining that the position is the predetermined one or not (Step 101). When the placement signal is issued and so that it is judged that the continuous paper sheet 1 is placed on the placement position (Step 102), a size measurement order signal is issued from the measurement control portion C and the driving motors 13 and 13a are driven. In consequence, the rotary shafts 11 and 11a are driven in order to move phototubes 12 and 18 along respective rotary shafts 11 and 11a (Step 103).

Concerning a width measurement process, the moving or travelling volume or distance measured

from the instant that light of the phototube 12 to be passed through the light transparent plate 7 is interrupted by the continuous paper sheet 1 to the instant that light of the phototube again passes through the light transparent plate 7 corresponds to the width of the continuous paper sheet 1. The number of slits corresponding to the moving distance above is counted in the slit detection apparatus 15 from the instant of interrupting the light to other instant of re-transmitting the light. The counted number is replaced by the moving distance of the phototube 12 and used as a width deterction signal which is outputted to the size control portion of the CPU 19 (Step 104). The size measurement portion of the CPU 19 compares the width detection signal to the width standard size previously set in the standard size setting portion in order to correct it to similar width standard size (Step 105). When a width detection signal corresponding to, for example, 3.24 inch is issued, the width standard size with a unit of 1/10 inch is set in the standard size setting portion, so that it is said the size of 3.24 inch is placed between 3.2 inch and 3.3 inch and it is corrected to 3.2 inch similar to 3.24. After that, the CPU 19 sent a drive control signal based on or according to the corrected value to the motor 40 (Step 106) and the distance between the wheels of the tractor 20 is controlled through the gear 41 so as to be match to the width of the continuous paper sheet 1 (Step 107).

While, in operation of the depth measurement process, because the phototube 18 is at its interrupted condition due to the continuous paper sheet 1 placed in the predetermined placement condition at its movement starting position, the slit number corresponding to the moving distance from the movement starting instant to the light transmitting instant is counted from the movement starting instant to the light passing instant. Then, the counted number or the corresponding moving distance is added to the distance from the position of the phtotube 18 to the position of the edge of the continuous paper sheet 1 at its initial position. The resultant sum is outputted to the size control portion of the CPU 19 as a depth detection signal of the continuous sheet 1 (Step 104). The size control portion compares the depth detection signal to the depth standard size previously set in the standard size setting portion in order to correct it to the similar or nearest depth standard size (Step 105). When a depth detection signal corresponding to 4.25 inch is outputted, because the depth standard size is set by units of 1/2 inch in the standard size setting portion, the size of 4.25 inch is said to be placed at the mid point between 4.0 inch and 4.5 inch. Raising the number, it is corrected to 4.5 inch.

Next, the CPU 19 sends a drive control signal according to the corrected number of 4.5 inch to a driving motor (not shown) for adjusting the position of the stopper 39 of the stacker device (Step 108) and the position of the stopper 39 is adjusted so as to fit to the depth of the unit sheet 1a (Step 109). The depth detection signal previously corrected is stored in a memory of the CPU 19.

Then, the continuous paper sheet 1 heaped on the stand 3 is pulled up and reachs the tractor 20 having two opposing wheels of a controlled separation distance through the guide plate 49. The marginal holes 6 and 6 of the continuous paper sheet 1 are engaged with the tractor pins planted on the tractor 20 and then the main motor 21 is driven. In consequence, the continuous paper sheet 1 is transferred to the right on the sheet of Fig 1 and the marginal portions or margins 5 and 5 are cut off by the slitter 24 at the transit instant of the moving sheet. The transfer speed of the sheet 1 is detected by the detector 23 and the result is sent to the CPU 19.

Next, the thickness of the continuous paper sheet 1 detected when it passes through the sheet thickness detectors 25a and 26b and the result of the detection signal is sent to the CPU 19. The vertical gaps of the upper and the lower feed-in rollers 26a and 26b and of the upper and the lower high speed rollers 27a and 27b are controlled by the CPU 19 treating the detection signal. The gap controlling process of the CPU 19 will be described with reference to Fig 8 and Fig 9. The axis of abscissa of the graph in Fig 9 shows the time starting from the instant of the continuous sheet edge detection.

As shown in the drawings, the sheet thickness detectors 25a and 25b detect the thickness (Step 201). When it is judged "thin" (Step 202), an on-off timing of the pulse motor 34 is set to a 12-pulse timing (Step 203). According to the 12-pulse timing shown in Fig 9, a drive signal is outputted to the pulse motor 34 at the instant earlier than the standard timing (in case of "middle" thickness) by a time of 2 pulses, which standard timing starts at the timing the sheet edge detection signal from the detector 29 inputs to the CPU 19. The standard timing in case of "middle" thickness corresponds to the sheet traveling or transfer speed and the depth of the unit sheet 1a. Another drive signal for returning the pulse motor stops at the instant later than the standard timing above by a time of 2 pulses. Consequently, the gap between the rollers at the instant the continuous sheet 1 reaches the upper and the lower rollers 26a, 26b and 27a, 27b is set to be narrower than the standard timing of the "middle" thickness.

When it is judged that the sheet thickness is not "thin" in Step 202, it will be judged that it is "middle" or not in Step 204. Then, the on-off

timing of the pulse motor 34 is set of a 10-pulse timing (Step 205) of the standard one. At the standard timing of the pulse motor 34, starting from the instant at which a sheet front edge detection signal from the sheet edge detector 29 inputs to the CPU 19, the CPU outputs a drive signal to the pulse motor 34 at the timing according to the depth of the unit sheet 1a and the sheet traveling speed. The standard gap of these upper and lower rollers equals to that obtained when the continuous paper sheet 1 reaches respective rollers 26a, 26b and 27a, 27b.

When the thickness of the sheet is not judged as "middle" in Step 204, the sheet is treated as the sheet is "thick" in Step 206 and the on-off timing of the pulse motor 34 is set at a 8-pulse timing (Step 207). According to the 8-pulse timing, it is apparent from Fig 9 that, starting at the instant the sheet edge detection signal from the sheet edge detector 29 inputs to the CPU 19, a drive signal is outputted from the CPU 19 to the pulse motor at the instant later than the standard timing (in case of "middle") according to the depth of the unit sheet 1a and the sheet traveling speed. While, the returning drive signal is stopped at the instant earlier than the standard timing by a time of 2 pulses. In consequence, the gap attained at the time the continuous sheet 1 reaches respective rollers 26a, 26b and 27a, 27b is set wider than that of the standard timing (in case of "middle").

In this manner, the thickness of the continuous paper sheet 1 is detected, then the front edge of the sheet is detected by the sheet edge detector 29, and information of the front edge detection signal inputs to the CPU 19. Receiving the front edge detection signal, the CPU 19 outputs a drive signal to the pulse motor 34 at a suitable timing determined according to the traveling speed, the corrected depth detection signal, and the thickness detection signal, respectively inputted to the CPU. Consequently, when the paper sheet 1 reaches the tearing-up position suitable to the depth corrected, both gaps between respective pairs of the upper and the lower feed-in rollers 26a,26b of the upper and the lower high speed rollers 27a, 27b become suitable to the actual thickness of the traveling sheet. The perforations 2 through which the continuous sheet is bent and torn are tensed and so pulled as to be torn by functions of respective pairs of rollers have a blade 28 applied thereto and the continuous sheet 1 is cut into the unit sheets 1a.

The unit paper sheets 1a cut are heapped one by one on the elevatable table 36 through the conveying guide belt 37. The position of the stopper 39 is already adjusted so as to be fitted to the depth of the unit sheets 1a, so that the sheet conveying motion to the table is done smoothly. When the level of the top unit sheet 1a of the heap becomes higher than that of the predetermined position, it is detected by a sheet stack volume detector 38, the resultant detection signal is sent to the CPU 19, the elevatable table 36 downs by the determined height in order to carry out always a smooth stacking operation.

Fig 10 shows another preferred embodiment of the continuous paper sheet tearing-up apparatus of the present invention, in which there is not tractor 20, and the transfer of the continuous paper sheet 1 is done by a feeding or in-feed portion having a sheet transfer function. As apparent from Fig 11 and Fig 12, the feeding portion includes a pair of the upper and the lower feed-in rollers, respectively apartable and approacheable along their vertical direction. Usually those opposed rollers are arranged with a gap of about 1 to 1.5 mm. The feeding rollers 56a and 56b, respectively have three dents or concaves 42a, 42b, 42c, 43a, 43b and 43c formed thereon as shown in Fig 12 so as to be separated along the longitudinal directions of the rollers 56a and 56b. A pair of curved or inverted J-shaped oscillating arms 45a and 45b are attached or installed in the concaves 42a and 42b of the upper feed-in roller 56a. The oscillating arms 45a and 45b have two rotable transfer rolls 44a and 44b at their ends. Respective other ends of the curved oscillating arms 45a and 45b are oscillatably held by a supporting rod 46 fixed to a machine frame (not shown). The oscillating arms 45a and 45b are adapted to be pressed so as to osciallate clockwise on the sheet of Fig 11 due to a compression or contraction force of the springs 48a and 48b arranged between the fixing plate 47 attached to the machine frame and parts adjacent to both other end of the oscillating arms. In consequence, the transfer rolls 44a and 44b supported at the ends of the oscillating arms rotatably contact with the outer periphery of the lower feed-in roller 56b. When the continuous paper sheet 1 is not cut, it is transferred by the operation of the lower feed-in roller 56b and the transfer rolls 44a and 44b. When respective feed-in rollers 56a, 56b approach mutually, respective transfer rolls 44a and 44b enter into the corresponding concaves 42a and 42b of the upper feed-in roller 56a against the compression forces of the springs 48a and 48b.

As shown in Fig 10, a transferred volume of the continuous paper sheet 1 or a transfer speed of the sheets through the feeding portion is detected by the detector 52 installed in a feeding roller encoder 51 for detecting the rotation number of the feed-in roller 56a and the resultant speed detection signal is sent to the CPU 19. The feed-in rollers 56a, 56b and the high speed rollers 27a, 27b are driven by the main motor 21 through a driving force transmitting mechanism (not shown).

In the preferred embodiments of the present

invention, any types of the continuous paper sheets 1 having margines 5 and 5 as described in the first embodiment and or not having them as these margines are cut off from the sheet may be used. In case that the continuous paper sheet 1 has each marginal portions 5 and 5, they are transferred without using these marginal portions 5 and 5. Because other embodiments of the continuous paper sheet tearing-up apparatus have the constructions similar to the first embodiment, the corresponding structural parts are shown by attaching the same numerals thereto and no explanation for the parts is provided in the specification. According to the preferred embodiment, the sheet size measurement device structures a tearing-up size inputting portion.

In the preferred embodiment, the continuous sheet 1 is pulled up one by one or gradually, led to between the feed-in rollers 56a and 56b through the guide plate 49, and nipped between the transfer rolls 44a, 44b and the lower feed-in roller 26a. Then, the main motor 21 is driven to transfer the continuous paper sheet 1. The following operation of the apparatus is the same as that of the first embodiment and its explanation is omitted.

According to the second embodiment of the present invention, there is no need to install any transfer mechanism for the continuous sheet 1 particularly, so that it is possible advantageously to simplify the construction of the whole construction of the continuous paper sheet tearing-up apparatus and to make it compact. Also, it is possible to construct the feed-in rollers 56a and 56b so as to always hold or nip the continuous paper sheet 1. In the case above, there is no need to install the transfer rolls 49a and 49b. It is also possible to input a tearing-up size of the sheet by manual operations, such as button pressing and the like.

It is still possible to employ in the third embodiment the feeding portion provided with feed-in rollers 56a and 56b described in the preferred second embodiment above in place of the feed-in rollers 26a and 26b used in the first embodiment of the present invention. According to the third embodiment, the sheet transferred volume through the feeding portion or the sheet travelling speed through the feeding portion are not detected through the rotation number of the feed-in rollers 56a and 56b and it is delected by using the detector 23 existed on the tractor encoder 22 so as to detect the rotation number of the tractor 20 having the same driving source as that of the first embodiment (see Fig 1).

The continuous paper sheet 1 usable in the third embodiment of the present invention includes the kinds of the sheet having marginal portions 5 and 5 and not having the marginal portions. That is, it is possible to transfer not only the continuous paper sheet 1 by using the marginal portions 5 and 5 adapted to be engaged with the tractor 20, but also by not using them eccept the feeding portion.

When the sheet 1 is transferred without using these marginal portions 5 and 5, two opposing parts of the tractor 20 are set to be separated by a rotation of the gear 41 to which a driving force of the motor 40 is given, together with the slitter 24 for cutting-off the marginal portions 5 and 5, so that the continuous sheet 1 can pass on the tractor 20 freely without no interruption.

It is noted that the present invention is not limited to respective embodiments mentioned above. It is not necessary to joint always operatively the control of the vertical gaps between the feed-in rollers 26a, 26b, 56a, 56b and the high speed rollers 27a and 27b to the detection of the sheet thickness. It is not limited to the pulse motor 34 of the driving source for narrowing the vertical gaps of the rollers. Further, it is possible to transfer the continuous paper sheet 1 by rollers and the like in place of the tractor 20. It is not always necessary to carry out the measurement of the width of the continuous paper sheet 1. The measurement of the width can be done by using some elements other than the phototubes 12 and 18, and various constructions of the sheet size measurement device can be used in the sheet tearing-up apparatus according to the present invention. It is also possible to use some manual inputting means, such as input buttons for inputting the thickness information of the continuous sheet 1 other than the automatic input means, such as the sheet thickness detectors 25a and 25b. The vertical gaps between the rollers 26a, 26b, 56a, 56b, 27a, 27b can be made unchangeable when the sheet is torn after the gaps are adjusted according to the sheet thickness. Furthermore, it is possible to set the tearing-up position of the continuous paper sheet 1 by controlling not only the vertical gap sizes between the feed-in rollers 26a, 26b, 56a, 56b and the high speed rolers 27a, 27b, but also the distance in the sheet ransfer direction between the positions of the feed-in rollers 26a, 26b, 56a, 56b and of the high speed rollers 27a, 27b.

As apparent from the foregoing explanation, the following effects are attained according to the present invention.

First, the continuous paper sheet can be torn correctly and precisely at the desired position of the sheet, because the width of the sheet folded is measured and respective pairs of the upper and the lower feed-in rollers and of the upper and the lower high speed rollers approach or move along the vertical direction on the basis of the measurement result.

Second, the continuous paper sheet can be precisely torn from the desired position, because

that the vertical gaps of the pairs of the upper and the lower feed-in rollers and of the upper and the lower high speed rollers are controlled according to the sheet thickness.

Third, the continuous paper sheet can be always and precisely torn from the desired position even though any error is generated in the sheet measurement, because the sheet tearing-up position on the sheet to be torn by respective pairs of the upper and the lower feed-in rollers and of the upper and the lower high speed rollers is determined and set according to the result which is obtained by measuring the depth of the continuous paper sheet and correcting the measured depth to the standard size.

Fourth, the size of the continuous paper sheet can be measured always precisely and the paper sheet can be torn correctly from the desired position always without tearing-up it from the wrong or erroneous position, because a detecting mechanism confirms that the continuous sheet is placed on the placement stand at the predetermined position when the size of the continuous paper sheet is measured.

Fifth, because that, when the feeding portion having a sheet transfer function is used in the continuous paper sheet tearing-up apparatus, the sheet tearing-up position is set by approaching the upper and the lower high speed rollers mutually according to the transfer volume and the torn size of the continuous paper sheet and the sheet edge detection signal, so that the continuous paper sheet is correctly torn from the desired position. And becuase that the feeding portion has a transfer function, any error due to the difference in the transfer volumes of the feeding portion and another transfer device is not generated and it becomes possible to always correctly tear-up the sheet from the desired position. Further because a particular or different transfer device is not need to install, the construction of the continuous paper sheet treating apparatus is simplified and made compact.

Claims

(1) A continuous paper sheet tearing-up apparatus comprising a pair of the upper rotatable feed-in roller and the lower rotatable feed-in roller, a pair of the upper high speed roller and the lower high speed roller rotatable at the higher speed than that of said feed-in rollers, said upper roller and said lower roller of respective pairs above being arranged so as to be apart from the opponent and move along the mutual separating and approaching direction, a blade arranged between the pair of the feed-in rollers and another pair of the high speed rollers, said upper feed-in roller and said lower feed-in roller and said upper high speed roller and said high speed roller approaching to each other and nip the sheet in order to give a transfer speed difference and tension to the sheet and at that instant said blade being applied to the sheet to tear-up the paper, a sheet size measurement apparatus for measuring at least a distance or width of the paper sheet folded, and an approaching timing control apparatus for controlling the instant at which said pair of the feed-in rollers and said pair of the high speed rollers according to the measurement result of the sheet size measurement apparatus.

(2) A continuous paper sheet tearing-up apparatus comprising a pair of the upper rotatable feed-in roller and the lower rotatable feed-in roller, a pair of the upper high speed roller and the lower high speed roller rotatable at the higher speed than that of said feed-in rollers, said upper roller and said lower roller of respective pairs above being arranged so as to be apart from the opponent and move along the mutual separating and approaching direction, a blade arranged between the pair of the feed-in rollers and another pair of the high speed rollers, said upper feed-in roller and said lower feed-in roller and said upper high speed roller and said high speed roller approaching to each other and nip the sheet in order to give a transfer speed difference and tension to the sheet and at that instant said blade being applied to the sheet to tear-up the paper, an inputting means for inputting information of the thickness of the continuous paper sheet to be torn, and a gap control means for controlling the vertical distance or gap between said pair of the feed-in rollers and said pair of the high speed rollers on the basis of the input signal from said inputting means.

(3) A continuous paper sheet tearing-up apparatus comprising a pair of the upper rotatable feed-in roller and the lower rotatable feed-in roller, a pair of the upper high speed roller and the lower high speed roller rotatable at the higher speed than that of said feed-in rollers, said upper roller and said lower roller of respective pairs above being arranged so as to be apart from the opponent and move along the mutual separating and approaching direction, a sheet size measurement apparatus for measuring at least a distance or width of the paper sheet folded, a standard size setting portion for previously setting a plurality of the kinds of the standard sizes of the continuous paper sheet, and a size adjusting portion for correcting or adjusting the measurement size of the continuous paper sheet measured by said sheet size measurement device to the approximate standard size on the basis of the standard size set by said standard size setting portion, in order to set the tearing-up position of the continuous paper sheet torn by said pair

of the feed-in rollers and said pair of the high speed rollers on the basis of the standard size of the continuous paper sheet corrected by the size adjusting portion.

(4) A continuous paper sheet tearing-up apparatus comprising a pair of the upper rotatable feed-in roller and the lower rotatable feed-in roller, a pair of the upper high speed roller and the lower high speed roller rotatable at the high speed than that of said feed-in rollers, said upper roller and said lower roller of respective pairs above being arranged so as to be apart from the opponent and move along the mutual separating and approaching direction, a balde arranged between the pair of the feed-in rollers and another pair of the high speed rollers, said upper feed-in roller and said lower feed-in roller and said upper high speed roller and said high speed roller approaching to each other and nip the sheet in order to give a transfer speed difference and tension to the sheet and at that instant said blade being applied to the sheet to tear-up the paper, a sheet size measurement apparatus for measuring at least a distance or width of the paper sheet folded and placed on a stand, a detection device for issuing a placement signal when the continuous paper sheet is placed on the stand at the predetermined position, and a measurement control portion for issuing a size measurement order signal to said sheet size measurement apparatus, in order to set the tearing-up position of the paper sheet torn by said pairs of the feed-in rollers and of the high speed rollers on the basis of the paper sheet size signal issued from the sheet size measurement apparatus.

(5) A continuous paper sheet tearing-up apparatus comprising a pair of the upper rotatable feed-in roller and the lower rotatable feed-in roller, a pair of the upper high speed roller and the lower high speed roller rotatable at the higher speed than that of said feed-in rollers, said upper roller and said lower roller of respective pairs above being arranged so as to be apart from the opponent and move along the mutual separating and approaching direction, a blade arranged between the pair of the feed-in rollers and another pair of the high speed rollers, said upper feed-in roller and said lower feed-in roller and said upper high speed roller and said high speed roller approaching to each other and nip the sheet in order to give a transfer speed difference and tension to the sheet and at that instant said blade being applied to the sheet to tear-up the paper, a feed-in portion provided with a pair of the upper feeding roller and the lower feeding roller for nipping the continuous paper sheet when the paper sheet is torn and for transferring the continuous paper sheet, said pair of the upper and the lower high speed rollers respectively being adapted to approach and nip the sheet when the paper sheet is torn, a sheet front edge detection portion for detecting a front edge of the continuous paper sheet transferred, a tearing-up size inputting portion for inputting a tearing-up size of the continuous paper sheet, and a control means for controlling the approaching operation of said pair of the upper and the lower high speed rollers on the basis of the volume of transferred sheet through said feeding portion and the tearing-up size signal from the tearing-up size inputting portion and the detection signal from the sheet front edge detection portion.

FIG. 1

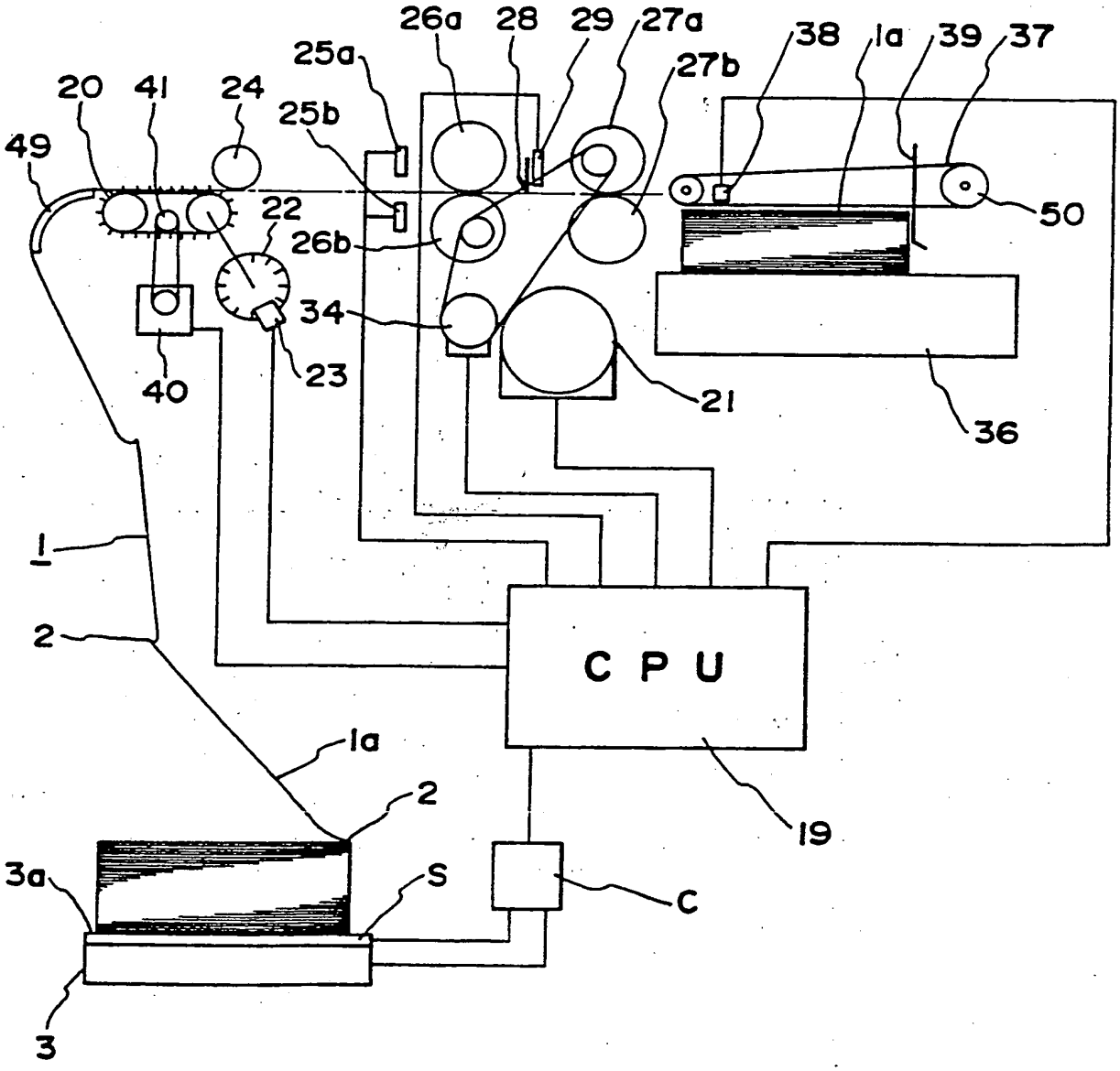

26a
28
29
27a
38
1a
39
37
25a
27b
20
41
24
25b
49
50
22
26b
34
40
23
21
36
1
2
C P U
1a
2
19
3a
S
C
3

FIG. 2

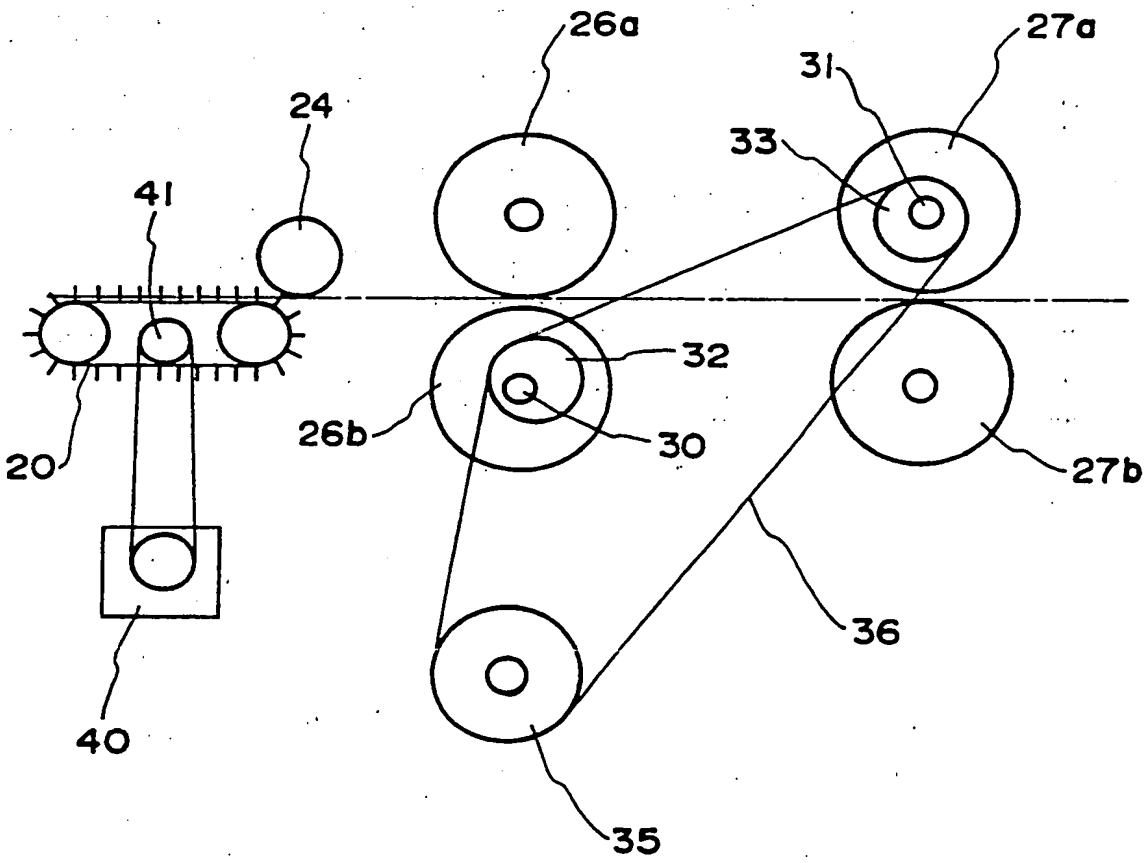


FIG 3

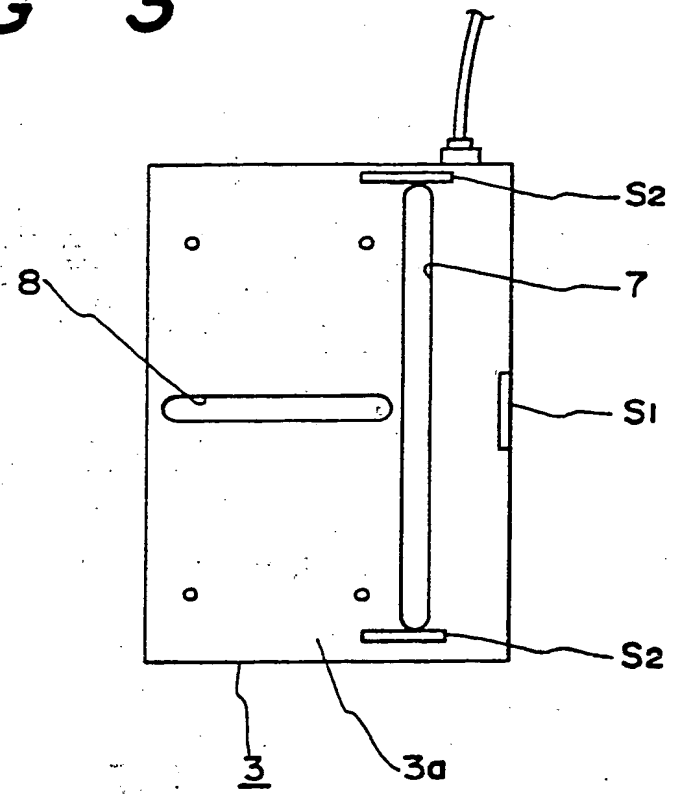


FIG. 4

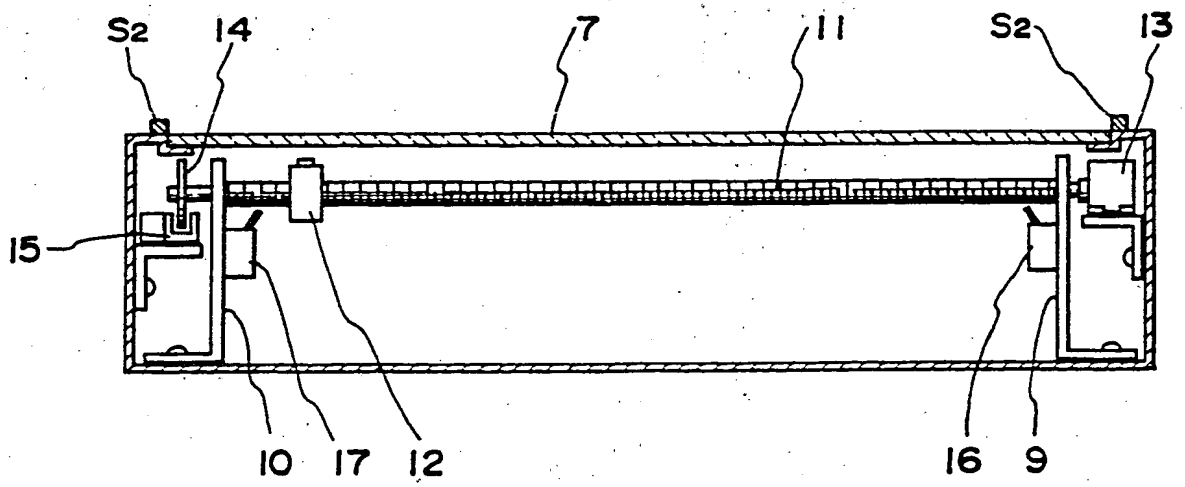


FIG. 5

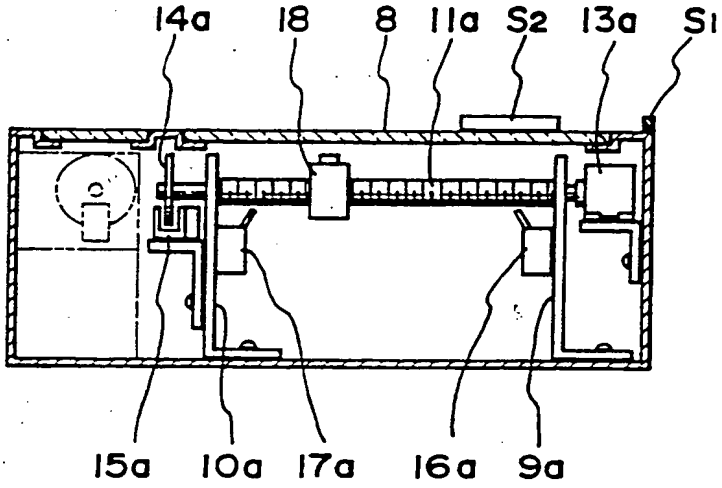


FIG. 6

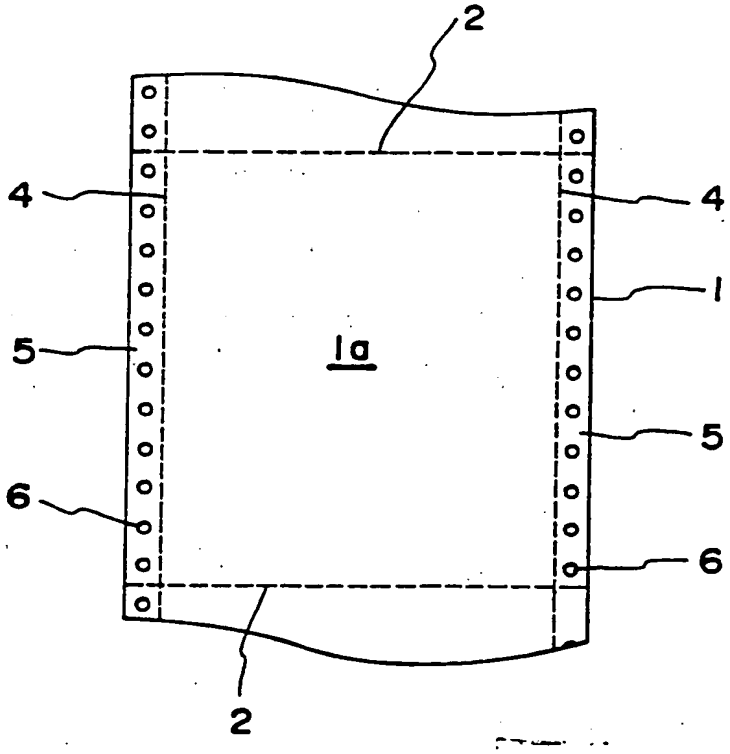


FIG 7

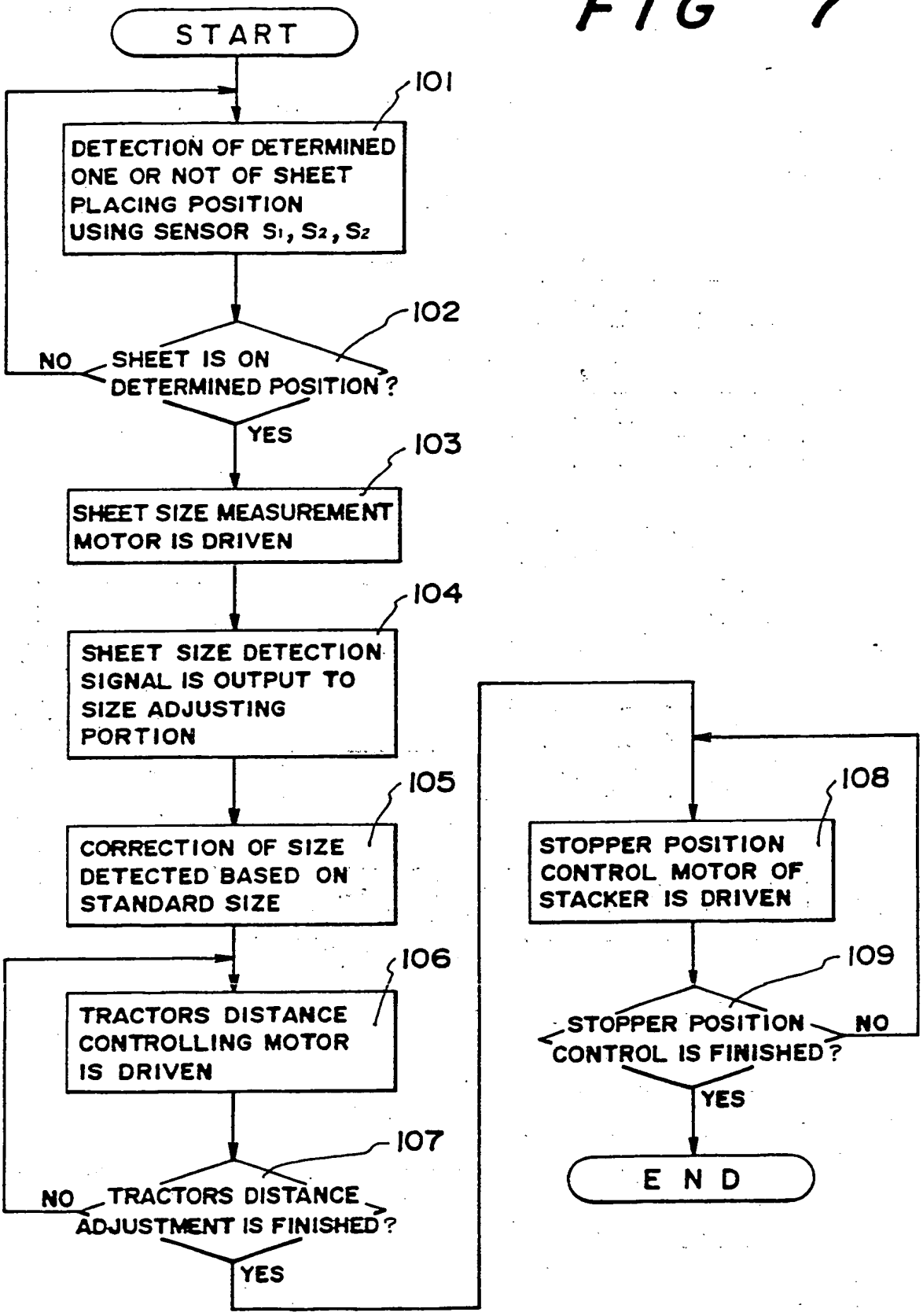

START
101
DETECTION OF DETERMINED ONE OR NOT OF SHEET PLACING POSITION USING SENSOR S1, S2, S2
102
NO
SHEET IS ON DETERMINED POSITION?
YES
103
SHEET SIZE MEASUREMENT MOTOR IS DRIVEN
104
SHEET SIZE DETECTION SIGNAL IS OUTPUT TO SIZE ADJUSTING PORTION
105
CORRECTION OF SIZE DETECTED BASED ON STANDARD SIZE
106
TRACTORS DISTANCE CONTROLLING MOTOR IS DRIVEN
107
NO
TRACTORS DISTANCE ADJUSTMENT IS FINISHED?
YES
108
STOPPER POSITION CONTROL MOTOR OF STACKER IS DRIVEN
109
STOPPER POSITION CONTROL IS FINISHED?
NO
YES
END

FIG. 8

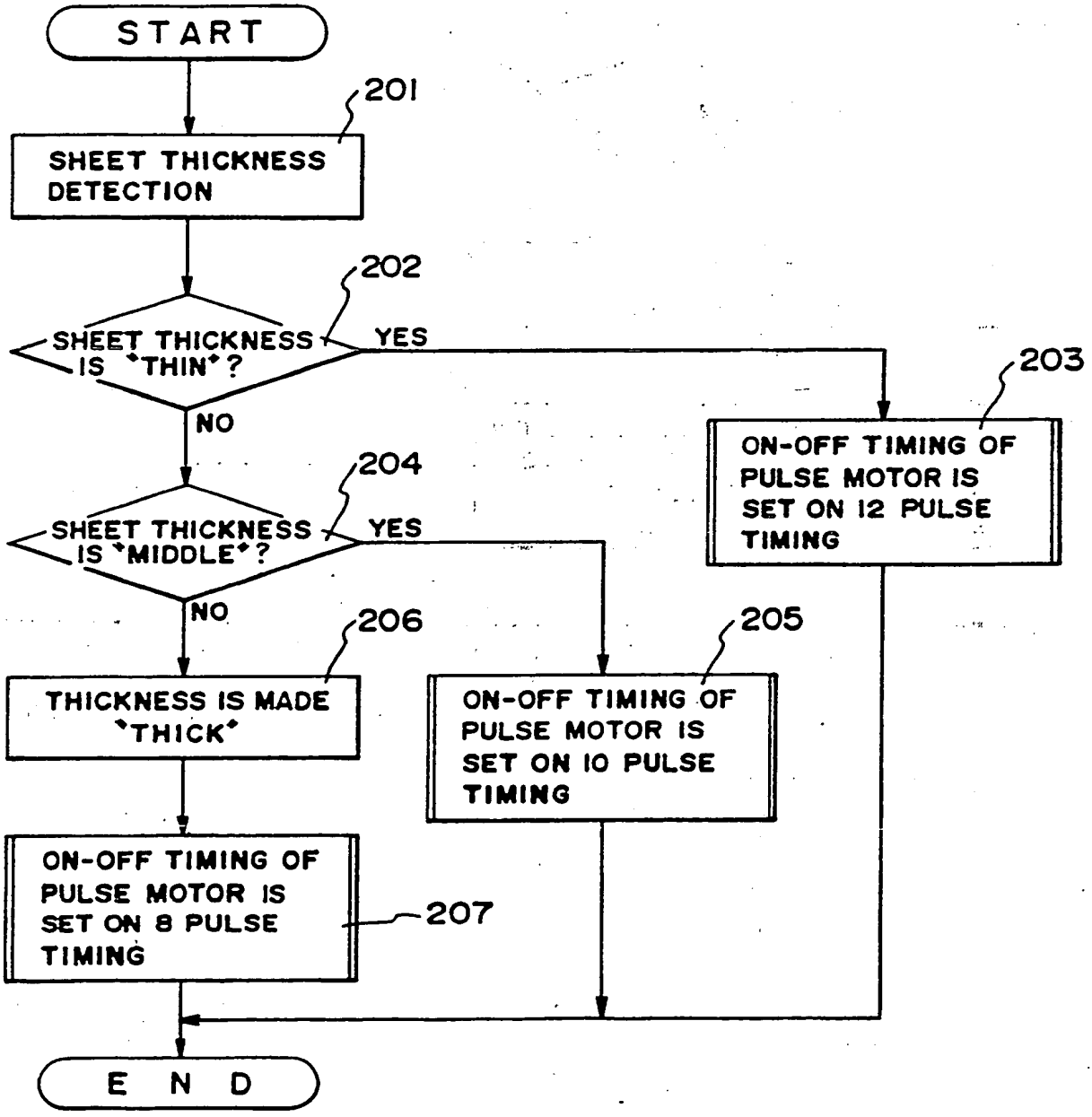

START
201
SHEET THICKNESS DETECTION
202
SHEET THICKNESS IS "THIN"?
YES
NO
203
ON-OFF TIMING OF PULSE MOTOR IS SET ON 12 PULSE TIMING
204
SHEET THICKNESS IS "MIDDLE"?
YES
NO
206
THICKNESS IS MADE "THICK"
205
ON-OFF TIMING OF PULSE MOTOR IS SET ON 10 PULSE TIMING
ON-OFF TIMING OF PULSE MOTOR IS SET ON 8 PULSE TIMING
207
E N D

FIG. 9

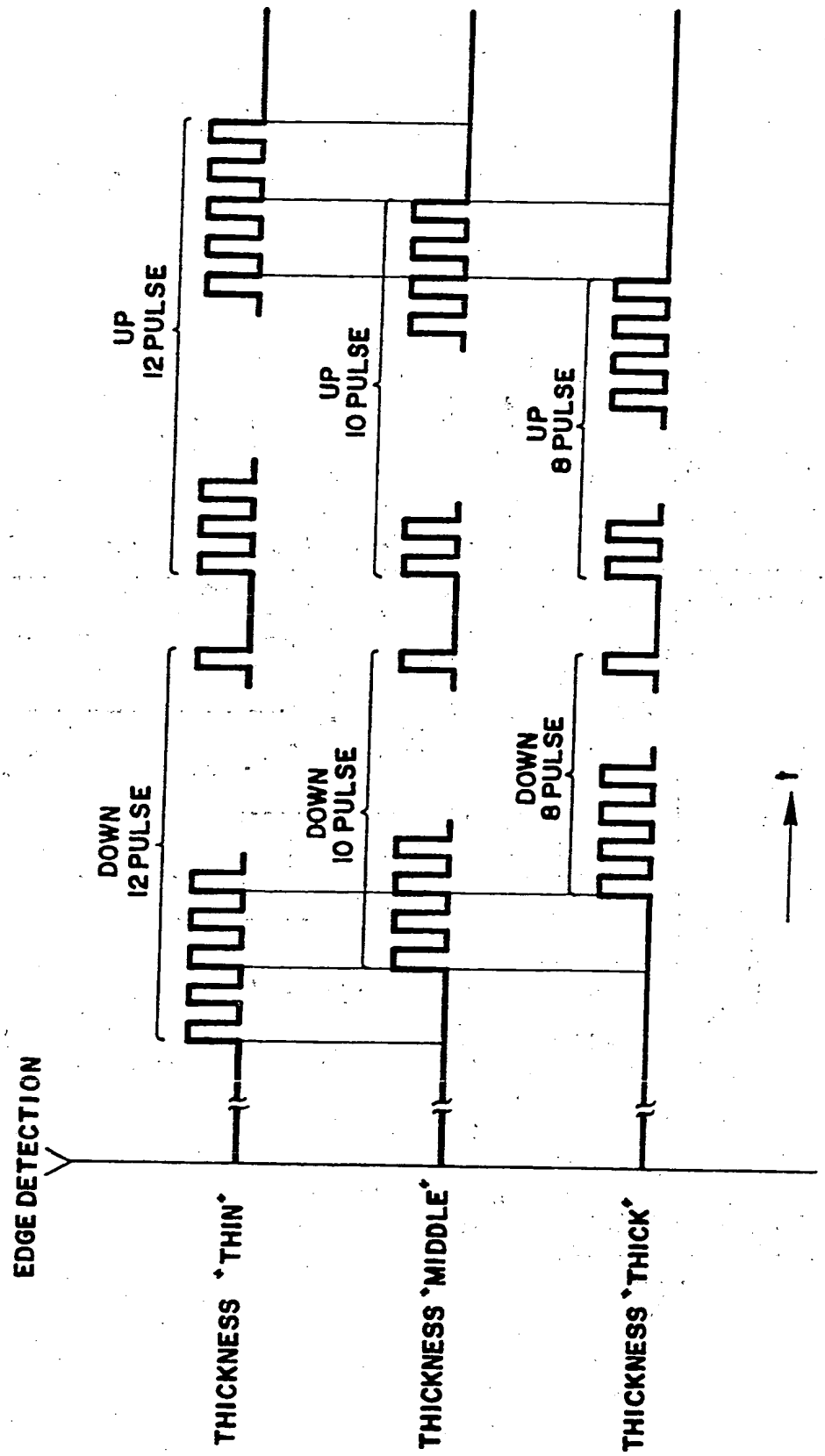

EDGE DETECTION
THICKNESS 'THIN'
THICKNESS 'MIDDLE'
THICKNESS 'THICK'
DOWN 12 PULSE
DOWN 10 PULSE
DOWN 8 PULSE
UP 12 PULSE
UP 10 PULSE
UP 8 PULSE
t

FIG. 10

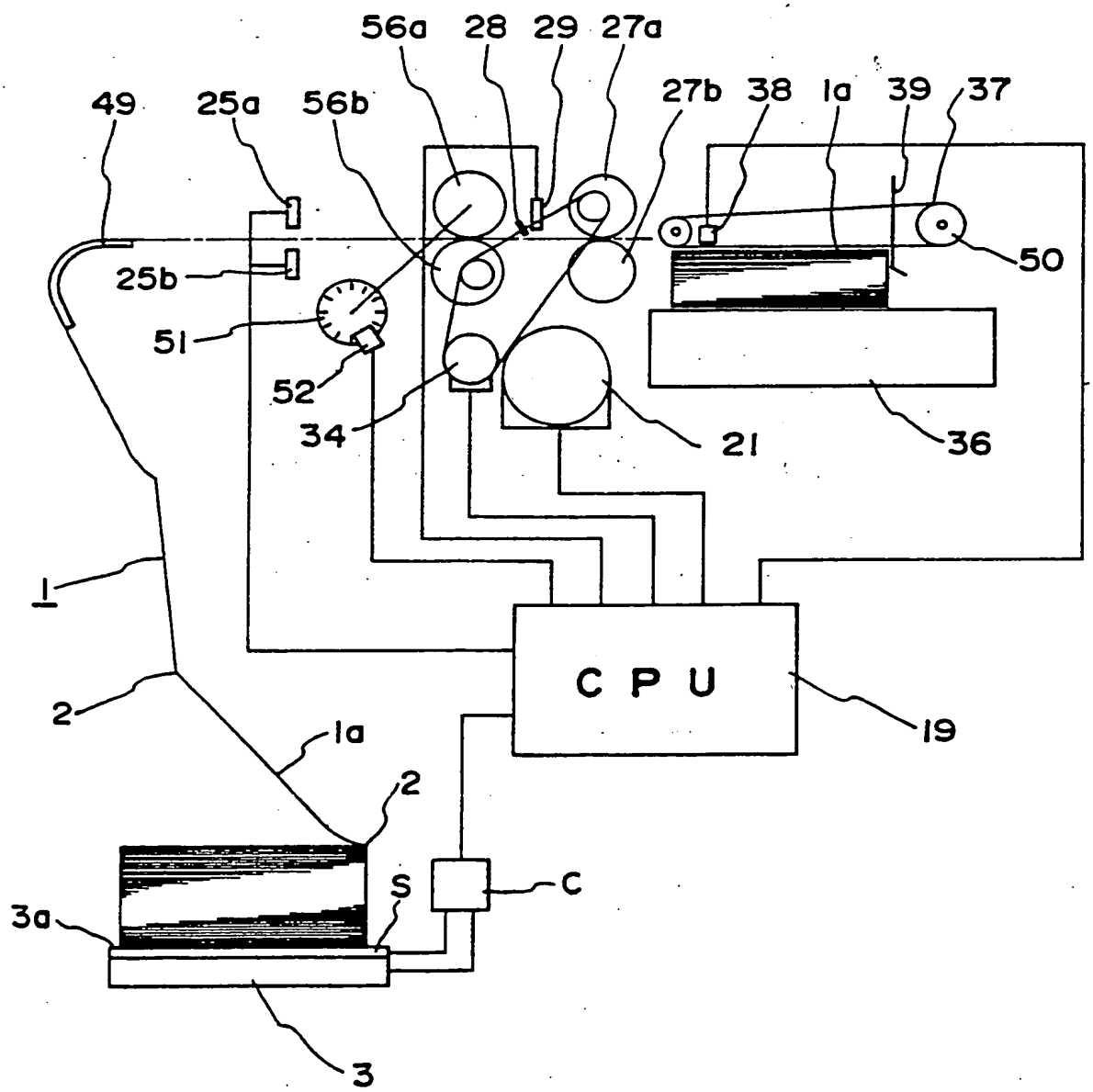


FIG. 11

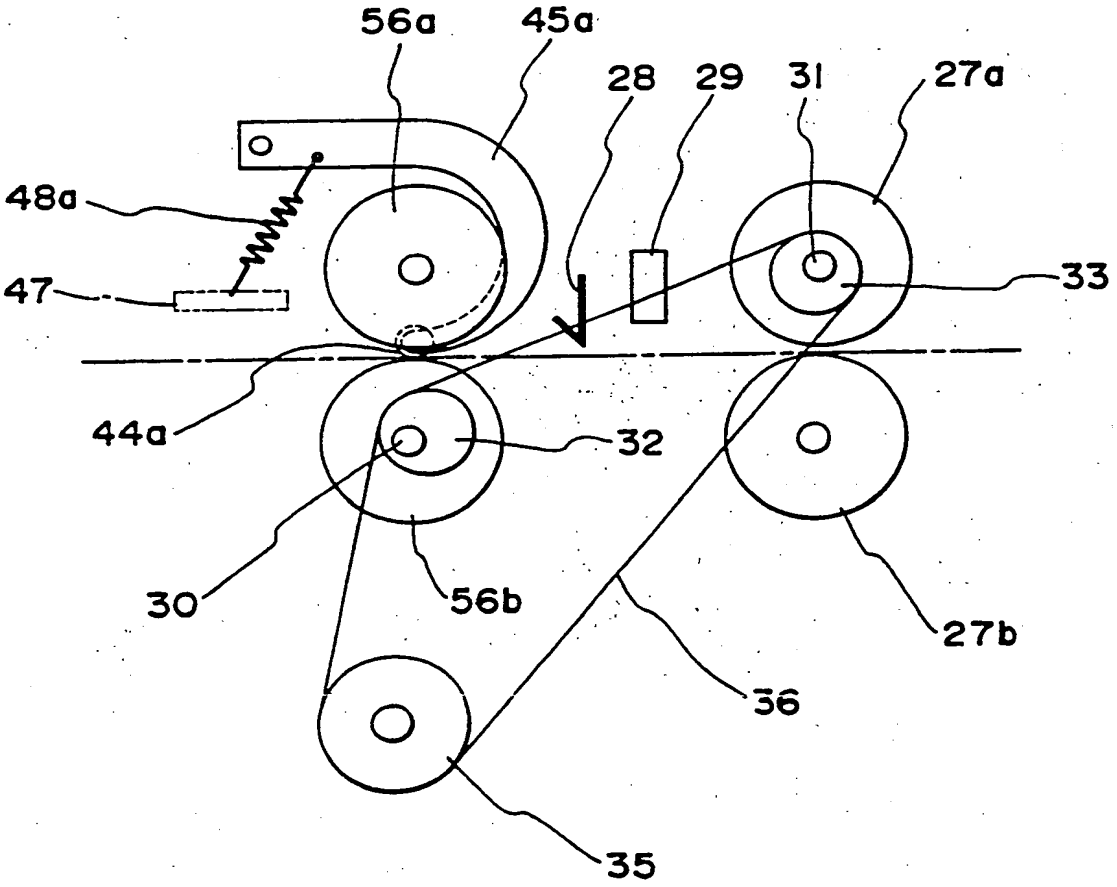
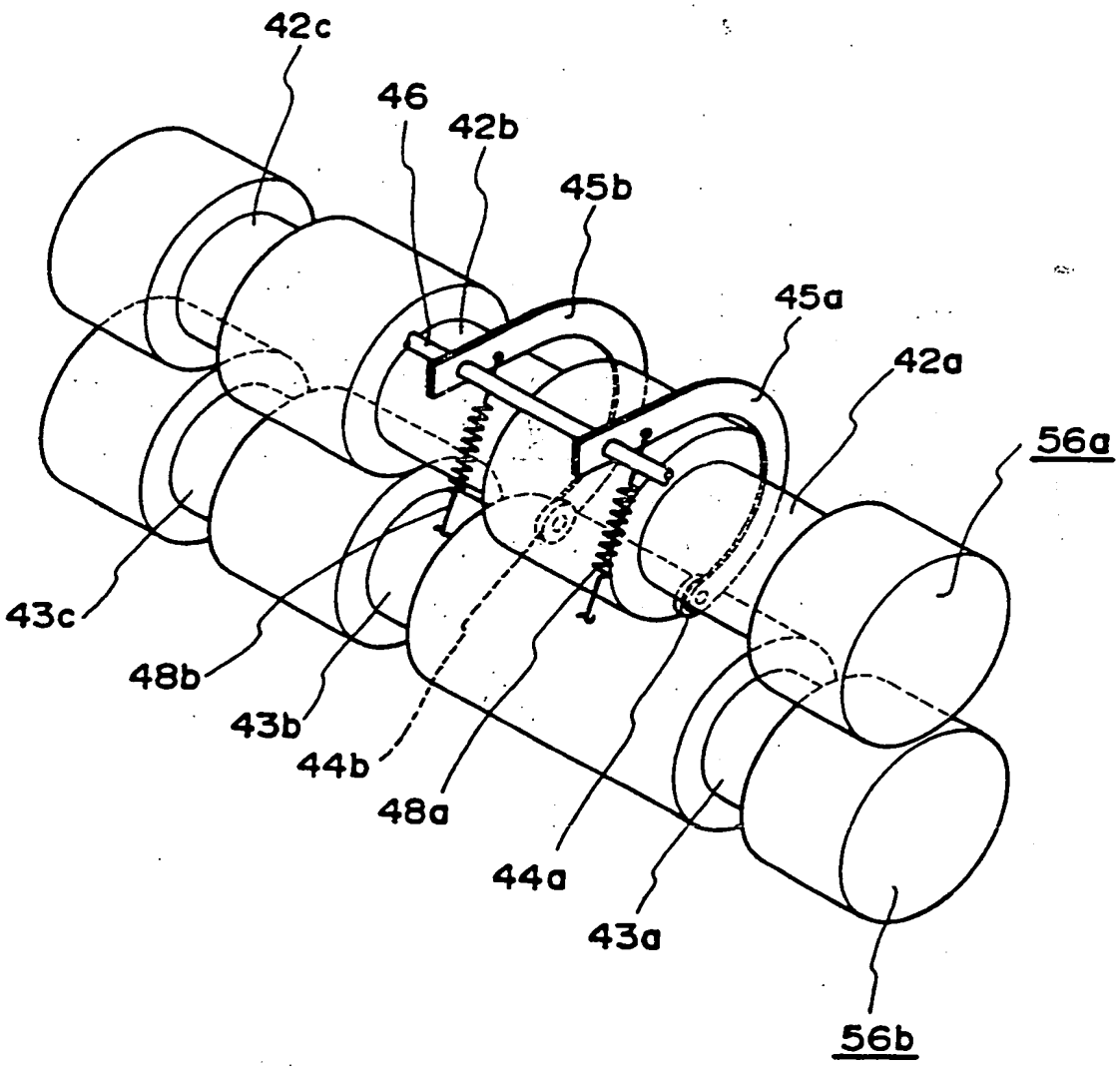


FIG. 12



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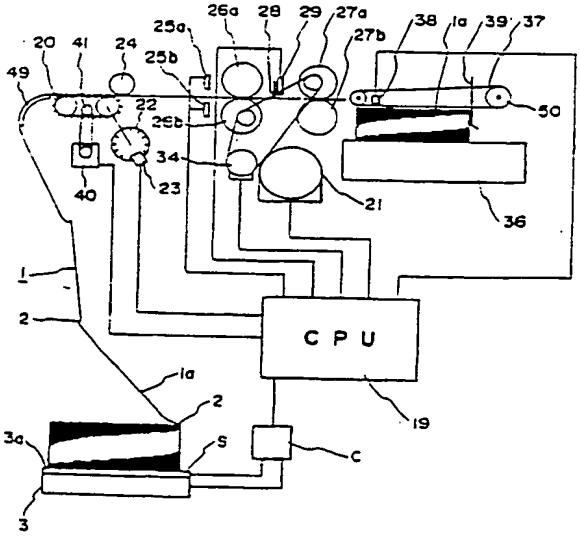
(54) Continuous paper sheet tearing-up apparatus.

(57) A continuous paper sheet having a plurality of transversal perforation lines and a plurality of holes formed in the longitudinal margines of the paper sheet. The paper sheet is torn by means of two pairs of nipping rollers including a pair of the upper and the lower feed-in rollers (26a,26b) and another pair of the upper and the lower pulling rollers (27a,27b). The pulling rollers of the latter pair rotate higher than that of the feed-in rollers of the former pair so that the part of the sheet placed between the former pair of rollers and the latter pair of rollers are pulled or given tension, being torn and separated. After the continuous paper sheet is confirmed that it is placed on a stand at the predetermined position, the width or distance of the continuous paper sheet folded is measured. The resultant of measurement is compared to the standard sizes previously inputted in a CPU in order to correct it to the approximate standard size. According to the corrected standard size and the sheet thickness separately measure, the tearing-up operation of the pairs of the feed-in rollers and of the high speed or pulling rollers is controlled in order to give the continuous paper sheet a difference in transferring speed and to tear-up the sheet at the predetermined position of the sheet.

FIG. 1



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 31 3706

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-134714 (MOORE BUSINESS FORMS) * page 4, line 1 - page 10, line 21; figures 1-9 *	1, 5	B65H35/10
A		2-4	
Y	EP-A-094647 (SYSTEMFORM DATENBELEGE) * page 9, line 15 - page 22, line 14; figures 1-6 *	1, 5	
A	DE-A-3500520 (PITNEY BOWES)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B65H
B26F
B41L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 OCTOBER 1990	LONCKE J.W.

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